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MAY.

Cleome pungens, Willd.
Malva sylvestris, L.
Cocculus Carolinus, DC.
Hypericum Canadense, L., var. major,
Drummondii, T. & G.
Polygala incarnata, L.
Erythrina herbacea, L.
Passiflora incarnata, L.
lutea, L.
Rhexia Mariana, L.
Hydrangea quercifolia, Bartram.
arborescens, L.
Hydrocotyle interrupta, Muhl.
Sanicula Canadensis, L.
Eryngium prostratum, Baldwin.
Discopleura capillacea, DC.
Thaspium barbinode, Nutt.
Sambucus Canadensis, L.
Lonicera sempervirens, Ait.
grata, Ait.
Cephalanthus occidentalis, L.
Galium hispidulum, Michx.
Helenium tenuifolium, Nutt.
Ceanothus Americana, L.

Desmodium paniculatum, DC.
Psoralea canescens, Michx.
[Gr.Tephrosia Virginica, Pers.
spicata, T. & G.
hispidula, Pursh.
Crotalaria Purshii, DC.
Solidago radula, Nutt.
Aster patens, Ait.
surculosus, Michx.
Echinacea augustifolia, DC.
Rudbeckia hirta, L.
Coreopsis lanceolata, L.
Helianthus occidentalis, T. & G.
doronicoides, Lam.
Cirsium Virginianum, Michx.
Pyrrhopappus Carolinianus, DC.
Oxydendrum arboreum, DC.
Solanum nigrum, L.
Carolinense, L.
Forsteronia difformis, A. DC.
Saururus cernuus, Willd.
Phytolacca decandra, L.
Callicarpa Americana, L.

MARTHA B. FLINT, *Brookhaven, Miss.*

"Beitraege zur Morphologie und Physiologie der Pilze, von A. DEBARY und M. WORONIN. Fuenfte Reihe. BEITRAG zur Kentniss der Ustilagineen, mit vier Tafeln."—In this important contribution to Mycological literature we have an attempt to form a philosophical system of classification of the *Ustilagineæ* upon the peculiarities of spore growth and "sporidia" production. It is quite needless to say that it is based upon the quiet assumption that the time has come for giving life history more, and a single phase of life history less weight in our systems of classification. Of course beside the leading idea of the contribution many isolated facts of value find place in this clearly written and beautifully illustrated memoir. We can only give the more important in this brief *resume.*

Plate I represents *Tuburcinia Trientalis*, which in its conidial state covers the under side of the leaves of *Trientalis Europæa*, L. The specimen was taken early in June. Sections made through the young leaves of the host show an abundant ramification of the cross-partitioned hyphæ beneath the epidermis, and between and into the chlorophyll-bearing cells. These threads reach the air *either through a stoma, or sometimes directly between the epidermis cells.* Some of the escaping threads creep in a tortuous manner over the leaf surface; others are erect and terminated by a single inversely pear-shaped conidium. Sowing these conidia on a growing Trientalis leaf and after a short time removing the epidermis it will be seen that the conidial threads have reached the interior of the leaf *between the cells of the epidermis.*

Plate II gives the condition of affairs in late summer, when a transverse section through the stem shows spore masses in the central, but more largely in the superficial parts of the preparation. The mode of formation of these spore masses is strikingly suggestive of other *Carposporeæ.* Essentially it consists in one or two end cells from the same or different threads becoming bladder-like [and contents dividing into spore masses?], whilst around these, delicate filaments spin themselves so quickly and closely that what transpires in the center can only be conjectured. This outer knot-like protecting case appears from the figures to be more or less completely absorbed or reduced by the growth and pressure of the spore masses.

Examining these affected Trientalis plants in the cold wet weather of autumn it will be discovered that the dark-brown spore masses show signs of growth. Placing these under a microscope and keeping them in a moist atmosphere one may see the individual spores sending out transparent thickish promycelia as growing tubes. Each of these tubes terminates in a basidial cell, which in turn produces 4 to 8 "primary sporidia." The use of the term sporidia in this sense is according to Tulasne. (The same word it is to be observed is used by our American botanists more frequently for the spore-like bodies found in asci of the Ascomycetous fungi.)

See plate III, figures 1-12. Between pairs of these "primary sporidia" copulation occurs at the base laterally, rarely at the summit. It appears that from these "primary sporidia" secondary ones may be produced directly, with or without a previous copulation. After the fall of the "sporidia," the basidia which supported them may give rise to delicate colorless threads. From the secondary sporidia tertiary ones may be produced and copulation occur between them. Or a sporidium may produce another sporidium on one side and on the other a growing tube. Not only two, but three or more primary sporidia may copulate and then may each produce secondary sporidia ; or a single sporidium which has not copulated may produce even three successive generations of sporidia. Evidently if this copulation, so-called, has anything whatever to do with reproduction or specific perpetuity, it sits very lightly, so far as necessity is concerned.

In from 15 to 20 days after sowing the conidia of *Tuburcinia* upon the Trientalis leaf the charasteristic black spots appear. Observation has made it very clear that both wind and insects by carrying the conidia aid in infecting plants previously healthy. These conidia, after sending their tubes between the epidermic cells of the host, develop around their point of entry a mycelium mass, each for itself, which remains well divided from those produced by other conidia. This *Tuburcinia Trientalis* furnishes, not the *first*, but the *best* illustration of conidial production among the *Ustilagineæ.*

Tuburcinia has both its conidia and its sporidia on the same host plant, as *Entyloma* has also, but the author hazards the conjecture that other links will be found, comparable to those of the *Uredineæ*, which will fairly make out another example of heterœcism.

For want of space we pass by the experiments upon *Sorospori-*

um Saponariæ, Rudolph, and *Sorosporium Junci*, Rudolph, which are regarded as representing different genera, and accordingly the latter is named *Tolysporium Junci.* Plate IV, figures 1, 2, 3, 4 show the spore masses of this last and the mode of germination: figures 5, 6, 7, 8 reveal the mode of production of the sporidia, which occur in whorls on the thickish, jointed promycelium and copulate by their upper ends.

Thecaphora hyalina, Fingerh., though it has been named *Sorosporium hyalinum*, is distinguished from this genus by both spore structure and mode of growth. As the period of vitality of these spores is but brief, all culture experiments with them must be made with fresh specimens. Plate III, fig 19, shows the brownish-yellow spore balls made up of from 2 to 20 verrucose spores. A very characteristic mark of these is the clear, round spot through which the germinating endospore tube protrudes. It is very suggestive of the Uredospores. This is shown by figures 20–22. Figures 24–26 show, instead of normal sporidia such as are found in *Tolysporium* and most of the *Ustilagineæ*, a number of lateral non-septate branches produced upon the septate promycelium and those (the former) of the same promycelium copulate by their extremities, to accomplish which the lower bend upward and the upper downward, after which a long cell develops, becomes septate, and then accumulates all the protoplasm in its terminal segment.

Sorosporium Astragali and *S. Desmodii*, both of Peck, are regarded on spore evidence as belonging to the genus *Thecaphora.*

Figures 9 and 10 of Plate IV are devoted to formation of sporidia by *Entyloma Eryngii;* 12–18 to *E. Aschersonii;* and 19–26 to *E. Magnusii.* Of these the last two species are removed from their former place in *Sorosporium* and on spore data placed in *Entyloma.* Whilst copulation of sporidia in *Entyloma* is common, it does not occur in *E. Aschersonii.* Figures 27–35 of the same plate show *Melanotænium endogenum*, de Bary, which grows on *Galium Mollugo* and *G. verum.* It was formerly known as *Protomyces endogenus*, Unger, and *P. Galii*, Rabh. Here we find strong mycelium and haustoria, the latter of which sometimes take up one-third of the cell intowhich they enter. The spores are dark-brown, oval, and germinate by protrusion of the endospore and production of a promycelium, and show in their mode of growth a relationship to *Entyloma*, as de Bary had suggested. From the summit of this strong promycelium several oblong sporidia develop and these copulate by their apices, of course while still attached to the promycelium.

The following is an abstract of the *Ustilagineæ* as arranged in this paper:

I. No "sporidia" produced directly from the growing spore.
  a. Spores produce many-celled tubes or threads, which remain either simple and unbranched, or whose terminal plasma-containing cell has several lateral, irregular, divided branches. The unbranched terminal joint can for a time live and grow if separated from the empty cells below.
    1. SOROSPORIUM, Rudolphi.
      S. Saponariæ, Rudolphi.

b. The threads from the spores produce a limited growth which develops into a promycelium; this instead of "sporidia" proper produces slender branches, which, growing toward each other, copulate by their ends. From this point of union another growth begins.

2 **Thecaphora**, Fingerh.

T. hyalina, Fingerh.

II. The promycelium by transverse septa divides itself into several cells from each of which one or more "sporidia" are produced.

3. **Ustilago**, Link. (Persoon, Tulasne.)

4. **Schizonella**, Schroeter (in Cohn's Beitr. z. Biol. d. Pfl. II Bd. p. 362.)

5. **Tolysporium**, mihi.

T. Junci. (Syn. Sorosporium Junci, Schr.)

III. The promycelium produces on its end a whorl of 2 to 8, usually spindle-shaped branches ("sporidia") which by pairs usually copulate sidewise. With or sometimes without this copulation these "sporidia" produce either secondary "sporidia," or long, simple or branched thin mycelial threads.

6. **Tilletia**, Tulasne.

7. **Entyloma**, de Bary. To which genus as before understood the two species *E. Aschersonii* and *E. Magnusii* are added

8. **Melanotænium**, de Bary.

M. endogenum, de Bary. This may yet be united with *Entyloma*.

9. **Schroeteria**, Winter.

Schr. Delastrina, Winter. (Syn. Geminella Delastrina. Schroeter.)

10. **Urocystis**, Rabenhorst. Of this genus the mode of growth of but four species has been observed, i. e. *U. occulta*, Rab., *U. pompholygodes*, Rab., *U. Violæ*, F. v. Wald., and *U. primulicola*, P. Magnus. *U. Corydalis*, Niessl., (in Thuemen Mycoth. 1626) is more nearly related to *Entyloma* as here understood, but is very different from *Entyloma Corydalis*, de Bary.

11. **Tuburcinia**, Fries.

T. Trientalis, Berkeley and Broome.

IV. Mode of growth unknown. Here however are placed all the species of *Sorosporium*, Rudolph, and *Thecaphora*, Fingerh., whose mode of growth has not been certainly shown; and also the genus

12. **Vossia**, Thuemen.

V. Molinæ, Thuem. (Winter had placed this under *Tilletia*.)

J. T. Rothrock.

Respiration of Plants.—We were once taught that one of the essential differences between animals and plants is that the former exhale carbonic acid and inhale oxygen, while in the latter the process is reversed. So long as chlorophyll-bearing plants alone were studied this view was to a certain extent excusable, for the more abundant effects of assimilation obscured the comparatively small effects of respiration. But modern investigation has come to a knowledge of the fact that the activities of every living cell. whether plant or animal, are similar, and that oxygen starvation is just as certain destruction for a plant cell as for an animal cell. The food used and the excretory products are in both cases the same. In regard to chlorophyll-bearing plants then the additional statement can be made that some plants differ from most animals and all other plants in being able to make their own food.